

Mars In Situ Sample Preparation and Distribution¹
Abstract
2002 Mars Sample Preparation Study Team
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In the next two decades several NASA missions to Mars are expected to acquire samples from the Martian surface and subsurface for in situ analysis by suites of onboard instruments. Some samples (especially rocks) will need preparation prior to analysis in order to achieve the desired science results. A key question is whether this preparation function should be distributed or common. Distributed systems have the advantage of relative independence of instrument design and operation. However, with constrained resources it may not be feasible for a spacecraft to carry multiple versions of crushers, for example. In March/April 2002 a study was carried out with broad participation from academia, institutions, and international space agencies to investigate the possible benefits and issues associated with using a common sample preparation and distribution (SPAD) system, in order to provide a comparison to the distributed case.

A survey of preparation needs of many in situ sample analysis instruments showed that the highest priority common needs were: coarse crushing, splitting (of crushed material), and purging between samples. Additional needs also exist for temporary sample storage, sieving, and environmental control. Other needs identified can wait for missions in the second decade.

A generic logic flow of a common system starts with Primary Analysis, which includes manipulation of the sample, inspection by imaging and spectrometer instruments, and, if appropriate, exposing fresh surfaces. A triage decision then sends the sample either directly to the Advanced Analysis System, to a bank, or to be discarded. The nature of the Advanced Analysis System is highly dependent on the particular set of instruments on a given mission, but it could include destructive analysis instruments as well as coarse and fine crushing.

Implementation options were studied and a mass perhaps as low as 10 kg appears possible for a simple SPAD system which could be developed for launches toward the end of this decade. In a distributed system, this mass could be allocated, instead, to other payload elements, such as individual PI instruments, to help offset the mass required for their preparation needs. Clearly the right balance needs to be found between sample acquisition, preparation, and analysis, with the evaluation metric being overall science value.

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